Apprenticeship and Industry Training

Automotive Service Technician

Apprenticeship Course Outline

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Government of Alberta

Apprenticeship and Industry Training

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Automotive Service Technician
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Course Outline

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Apprenticeship

Apprenticeship is post-secondary education with a difference. Apprenticeship begins with finding an employer. Employers hire apprentices, pay their wages and provide on-the-job training and work experience. Approximately 80 per cent of an apprentice's time is spent on the job under the supervision of a certified journeyperson or qualified tradesperson. The other 20 per cent involves technical training provided at, or through, a post-secondary institution – usually a college or technical institute.

To become certified journeypersons, apprentices must learn theory and skills, and they must pass examinations. Requirements for certification—including the content and delivery of technical training—are developed and updated by the Alberta Apprenticeship and Industry Training Board on the recommendation of Automotive Service Technician Provincial Apprenticeship Committee.

The graduate of the Automotive Service Technician apprenticeship program is a certified journeyperson who will be able to:

- repair, maintain and overhaul or modify a motor vehicle
- comprehend work orders, technical bulletins and estimates, and relate the information to the job at hand
- interpret warranty policy in terms of service reports, component failures and analysis records
- perform assigned tasks in accordance with quality and production standards required by industry

After earning a journeyman certificate the Automotive Service Technician may opt to specialize in the repairing, rebuilding and servicing of any one or more of the many assemblies of the modern automobile.

Executive and supervisory opportunities in the automotive industry are frequently available to trained and certified mechanics with above average capabilities and motivation.

It is advantageous for the Automotive Service Technician to be familiar with the work experience of closely allied trades; eg. Heavy Equipment Technician, Auto Body Technician, Machinist and Welder Apprenticeship and Industry Training Committee Structure.

Apprenticeship and Industry Training System

Industry-Driven

Alberta's apprenticeship and industry training system is an industry-driven system that ensures a highly skilled, internationally competitive workforce in more than 50 designated trades and occupations. This workforce supports the economic progress of Alberta and its competitive role in the global market. Industry (employers and employees) establishes training and certification standards and provides direction to the system through an industry committee network and the Alberta Apprenticeship and Industry Training Board. The Alberta government provides the legislative framework and administrative support for the apprenticeship and industry training system.

Alberta Apprenticeship and Industry Training Board

The Alberta Apprenticeship and Industry Training Board provides a leadership role in developing Alberta's highly skilled and trained workforce. The board's primary responsibility is to establish the standards and requirements for training and certification in programs under the Apprenticeship and Industry Training Act. The board also provides advice to the Minister of Advanced Education and Technology on the needs of Alberta's labour market for skilled and trained workers, and the designation of trades and occupations.

The thirteen-member board consists of a chair, eight members representing trades and four members representing other industries. There are equal numbers of employer and employee representatives.

Industry Committee Network

Alberta's apprenticeship and industry training system relies on a network of industry committees, including local and provincial apprenticeship committees in the designated trades, and occupational committees in the designated occupations. The network also includes other committees such as provisional committees that are established before the designation of a new trade or occupation comes into effect. All trade committees are composed of equal numbers of employer and employee representatives. The industry committee network is the foundation of Alberta's apprenticeship and industry training system.

Local Apprenticeship Committees (LAC)

Wherever there is activity in a trade, the board can set up a local apprenticeship committee. The board appoints equal numbers of employee and employer representatives for terms of up to three years. The committee appoints a member as presiding officer. Local apprenticeship committees:

- monitor apprenticeship programs and the progress of apprentices in their trade, at the local level
- make recommendations to their trade's provincial apprenticeship committee (PAC) about apprenticeship and certification in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- make recommendations to the board about the appointment of members to their trade's PAC
- help settle certain kinds of disagreements between apprentices and their employers
- carry out functions assigned by their trade's PAC or the board

Provincial Apprenticeship Committees (PAC)

The board establishes a provincial apprenticeship committee for each trade. It appoints an equal number of employer and employee representatives, and, on the PAC's recommendation, a presiding officer - each for a maximum of two terms of up to three years. Most PACs have nine members but can have as many as twenty-one. Provincial apprenticeship committees:

- Make recommendations to the board about:
    - standards and requirements for training and certification in their trade
    - courses and examinations in their trade
    - apprenticeship and certification
    - designation of trades and occupations
    - regulations and orders under the Apprenticeship and Industry Training Act
- monitor the activities of local apprenticeship committees in their trade
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- consult with other committees under the Apprenticeship and Industry Training Act about apprenticeship programs, training and certification and facilitate cooperation between different trades and occupations
- consult with organizations, associations and people who have an interest in their trade and with employers and employees in their trade
- may participate in resolving certain disagreements between employers and employees
- carry out functions assigned by the board

Automotive Service Technician PAC Members at the Time of Publication

Mr. D. Wild	Lethbridge	Presiding Officer
Mr. P. Hrynew	Edmonton	Employer
Mr. G. Schroder	Edmonton	Employer
Mr. M. Kurpjuweit	Medicine Hat	Employer
Mr. C. Donaghy	Red Deer	Employer
Mr. H. Sparrow	Vermilion	Employer
Mr. K. Alguire	Calgary	Employee
Mr. J. Kokot	Calgary	Employee
Mr. W. Keen	Edmonton	Employee
Mr. M. McRorie	Edmonton	Employee
Mr. I. Geisbrecht	Grande Prairie	Employee

Alberta Government

Alberta Advanced Education and Technology works with industry, employer and employee organizations and technical training providers to:

- facilitate industry's development and maintenance of training and certification standards
- provide registration and counselling services to apprentices and employers
- coordinate technical training in collaboration with training providers
- certify apprentices and others who meet industry standards

Technical Institutes and Colleges

The technical institutes and colleges are key participants in Alberta's apprenticeship and industry training system. They work with the board, industry committees and Alberta Advanced Education and Technology to enhance access and responsiveness to industry needs through the delivery of the technical training component of apprenticeship programs. They develop lesson plans from the course outlines established by industry and provide technical training to apprentices.

Apprenticeship Safety

Safe working procedures and conditions, incident/injury prevention, and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, employers, employees, apprentices and the public. Therefore, it is imperative that all parties are aware of circumstances that may lead to injury or harm.

Safe learning experiences and healthy environments can be created by controlling the variables and behaviours that may contribute to or cause an incident or injury. By practicing a safe and healthy attitude, everyone can enjoy the benefit of an incident and injury free environment.

Alberta Apprenticeship and Industry Training Board Safety Policy

The Alberta Apprenticeship and Industry Training Board fully supports safe learning and working environments and encourages the teaching of proper safety procedures both within trade specific training and in the workplace.

Trade specific safety training is an integral component of technical training, while ongoing or general non-trade specific safety training remains the responsibility of the employer and the employee as required under workplace health and safety legislation.

Workplace Responsibilities

The employer is responsible for:

- training employees and apprentices in the safe use and operation of equipment
- providing and maintaining safety equipment, protective devices and clothing
- enforcing safe working procedures
- providing safeguards for machinery, equipment and tools
- observing all accident prevention regulations

The employee and apprentice are responsible for:

- working in accordance with the safety regulations pertaining to the job environment
- working in such a way as not to endanger themselves, fellow employees or apprentices

Workplace Health and Safety

A tradesperson is often exposed to more hazards than any other person in the work force and therefore should be familiar with and apply the Occupational Health and Safety Act, Regulations and Code when dealing with personal safety and the special safety rules that apply to all daily tasks.

Workplace Health and Safety (Alberta Employment, Immigration and Industry) conducts periodic inspections of workplaces to ensure that safety regulations for industry are being observed.

Additional information is available at www.worksafely.org

Technical Training

Apprenticeship technical training is delivered by the technical institutes and many colleges in the public post-secondary system throughout Alberta. The colleges and institutes are committed to delivering the technical training component of Alberta apprenticeship programs in a safe, efficient and effective manner. All training providers place great emphasis on safe technical practices that complement safe workplace practices and help to develop a skilled, safe workforce.

The following institutions deliver Automotive Service Technician apprenticeship technical training:

Northern Alberta Institute of Technology (main campus)
Medicine Hat College
Lethbridge College
Southern Alberta Institute of Technology (main campus)
Northern Alberta Institute of Technology (Fairview campus)
Lakeland College
Red Deer College

Procedures for Recommending Revisions to the Course Outline

Advanced Education and Technology has prepared this course outline in partnership with the Automotive Service Technician Provincial Apprenticeship Committee.

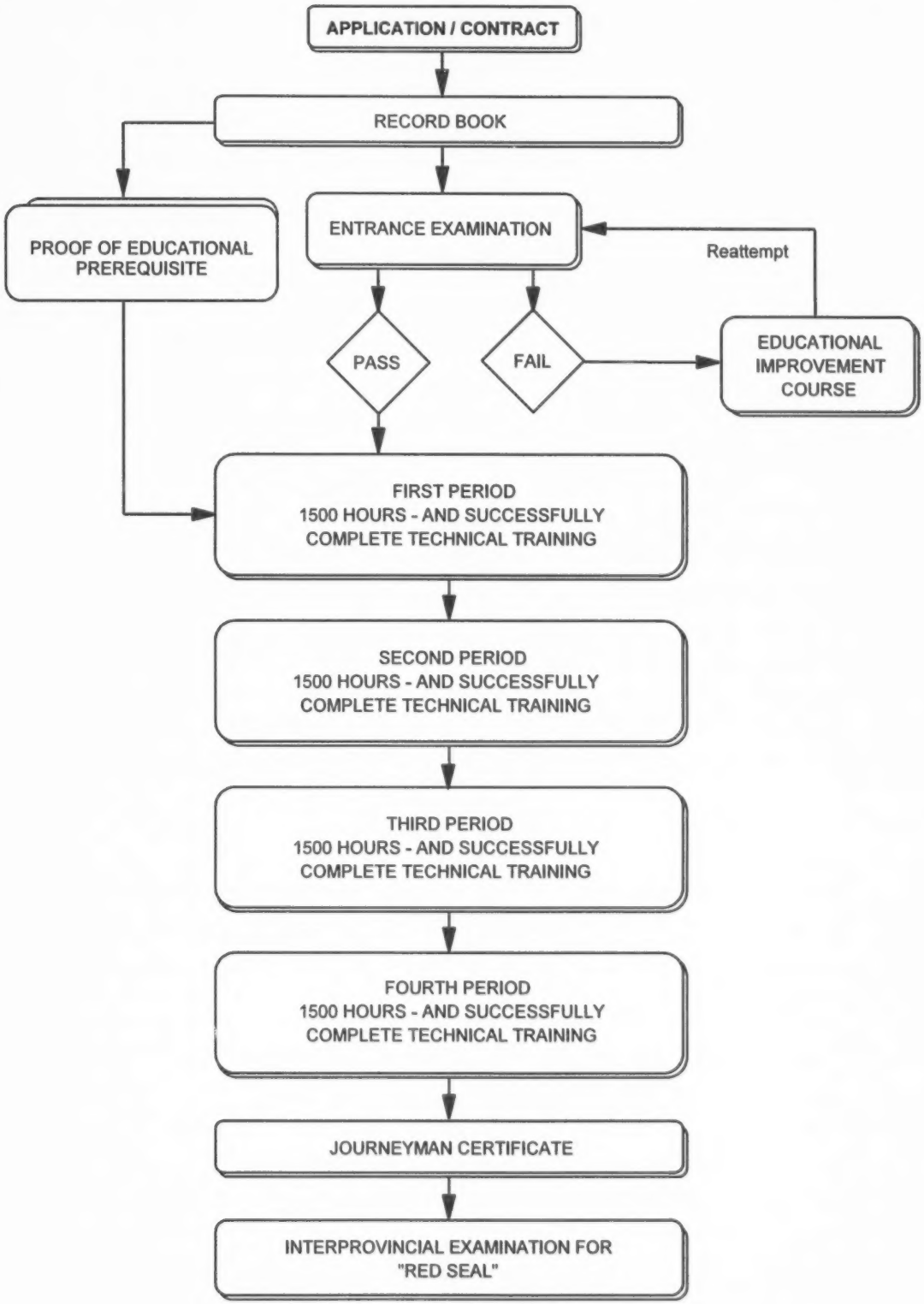
This course outline was approved on February 9, 2004 by the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. The valuable input provided by representatives of industry and the institutions that provide the technical training is acknowledged.

Any concerned individual or group in the province of Alberta may make recommendations for change by writing to:

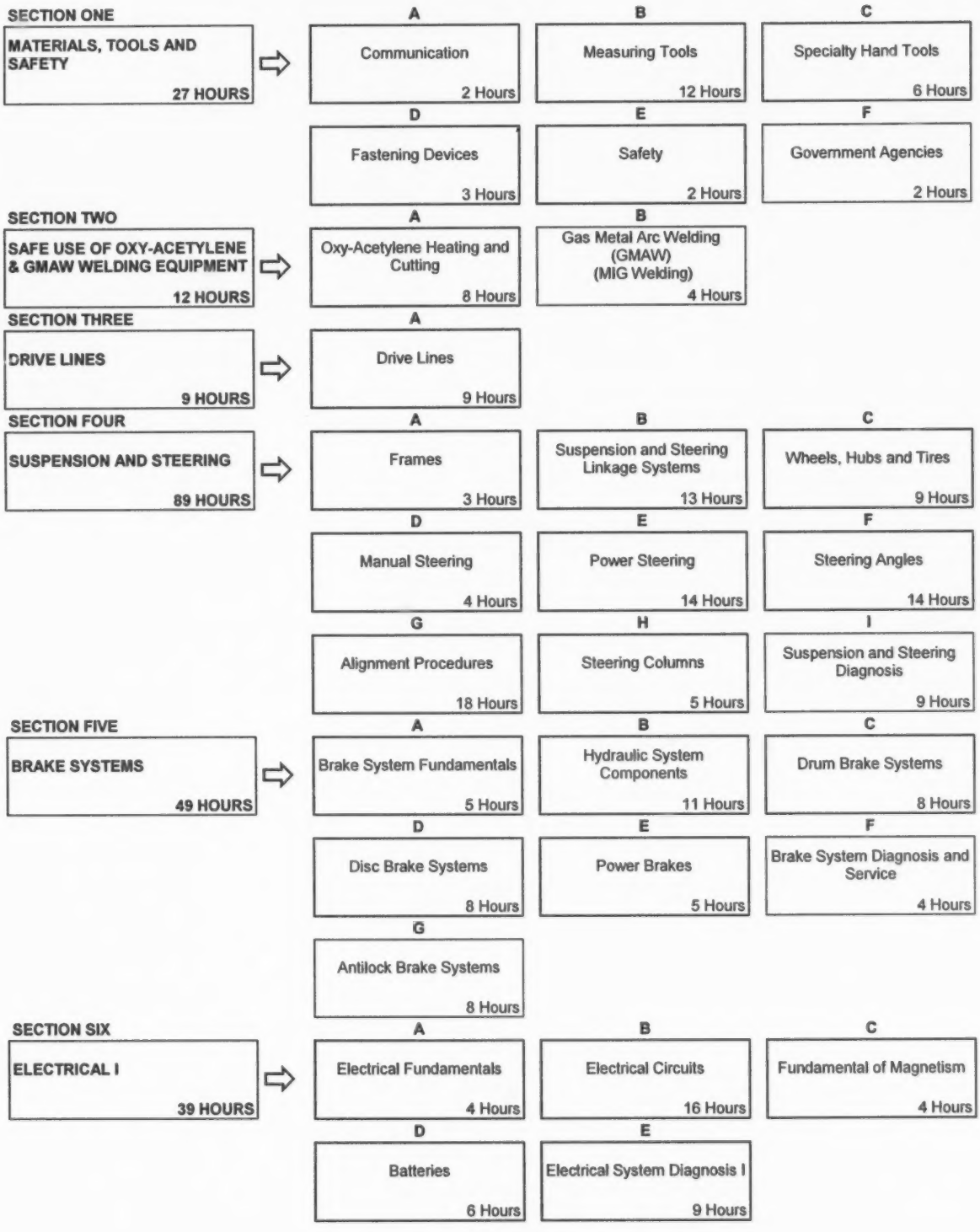
Automotive Service Technician Provincial Apprenticeship Committee
c/o Industry Programs and Standards
Apprenticeship and Industry Training
Advanced Education and Technology
10th floor, Commerce Place
10155 102 Street NW
Edmonton AB T5J 4L5

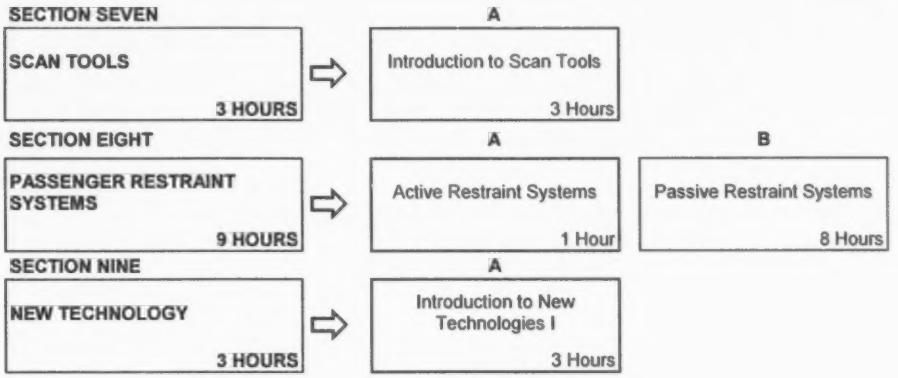
It is requested that recommendations for change refer to specific areas and state references used. Recommendations for change will be placed on the agenda for regular meetings of the Automotive Service Technician Provincial Apprenticeship Committee.

Apprenticeship Route toward Certification

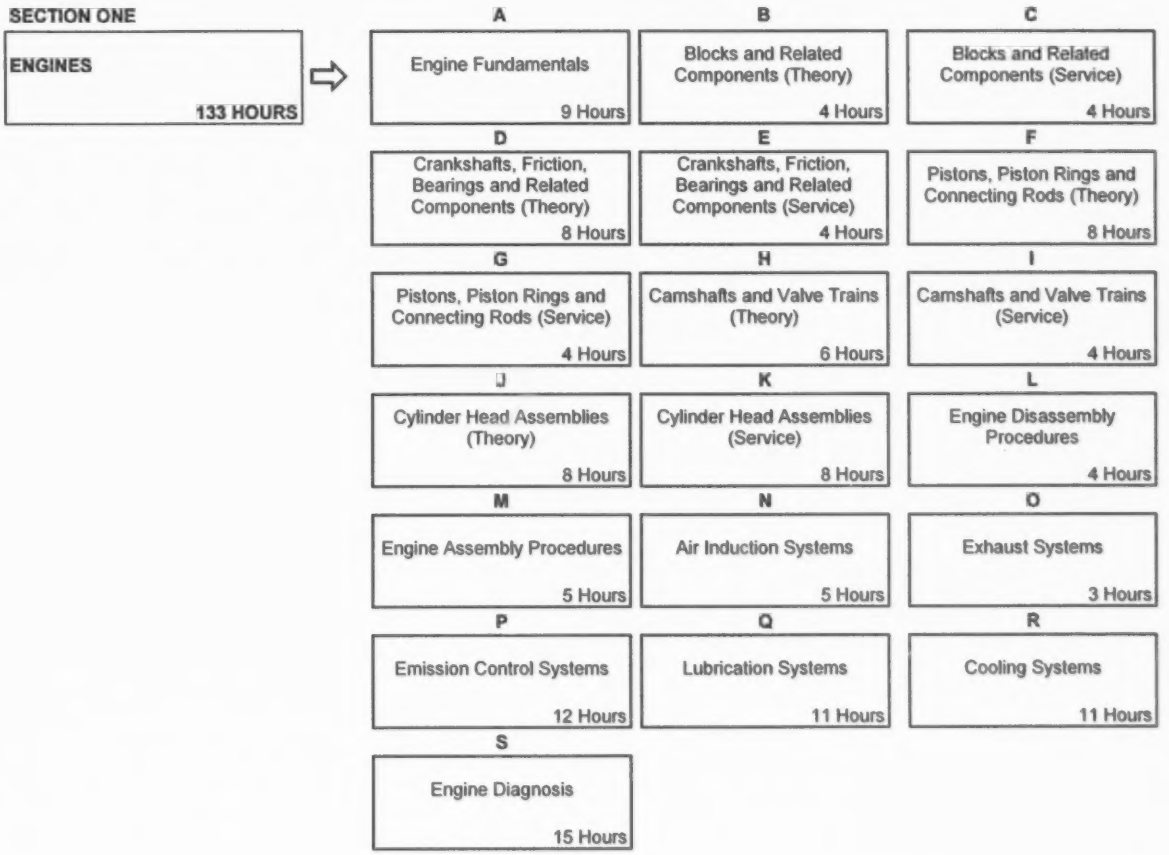


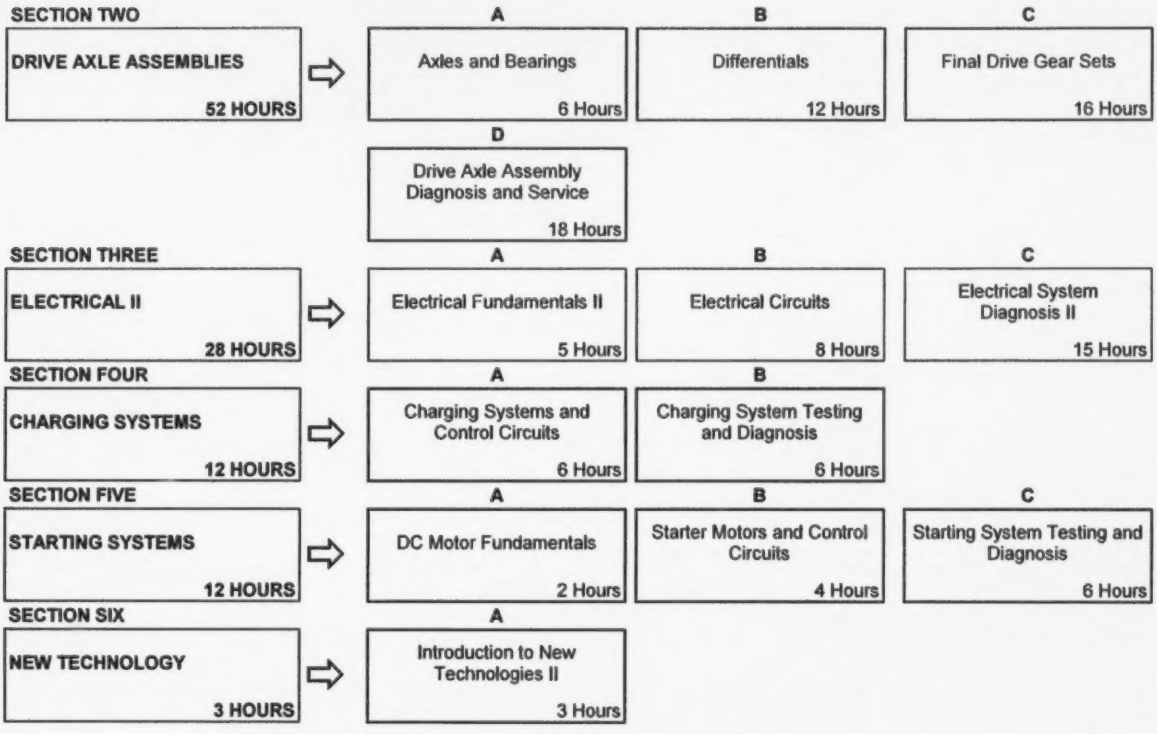
Automotive Service Technician Training Profile
First Period
(240 Hours)





Automotive Service Technician Training Profile
Second Period
(240 Hours)





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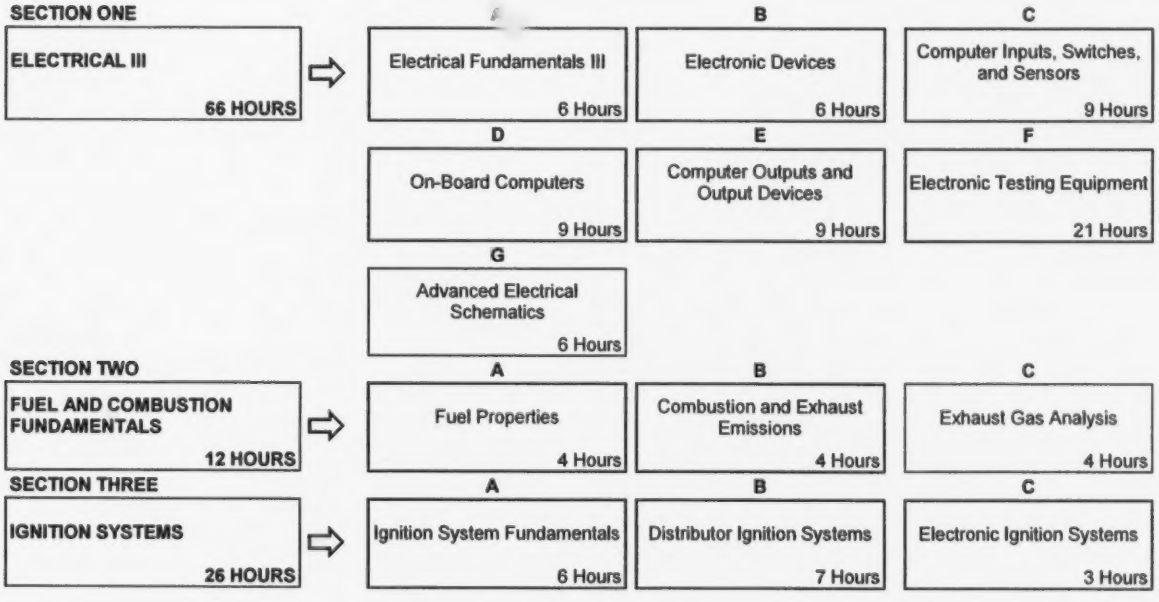
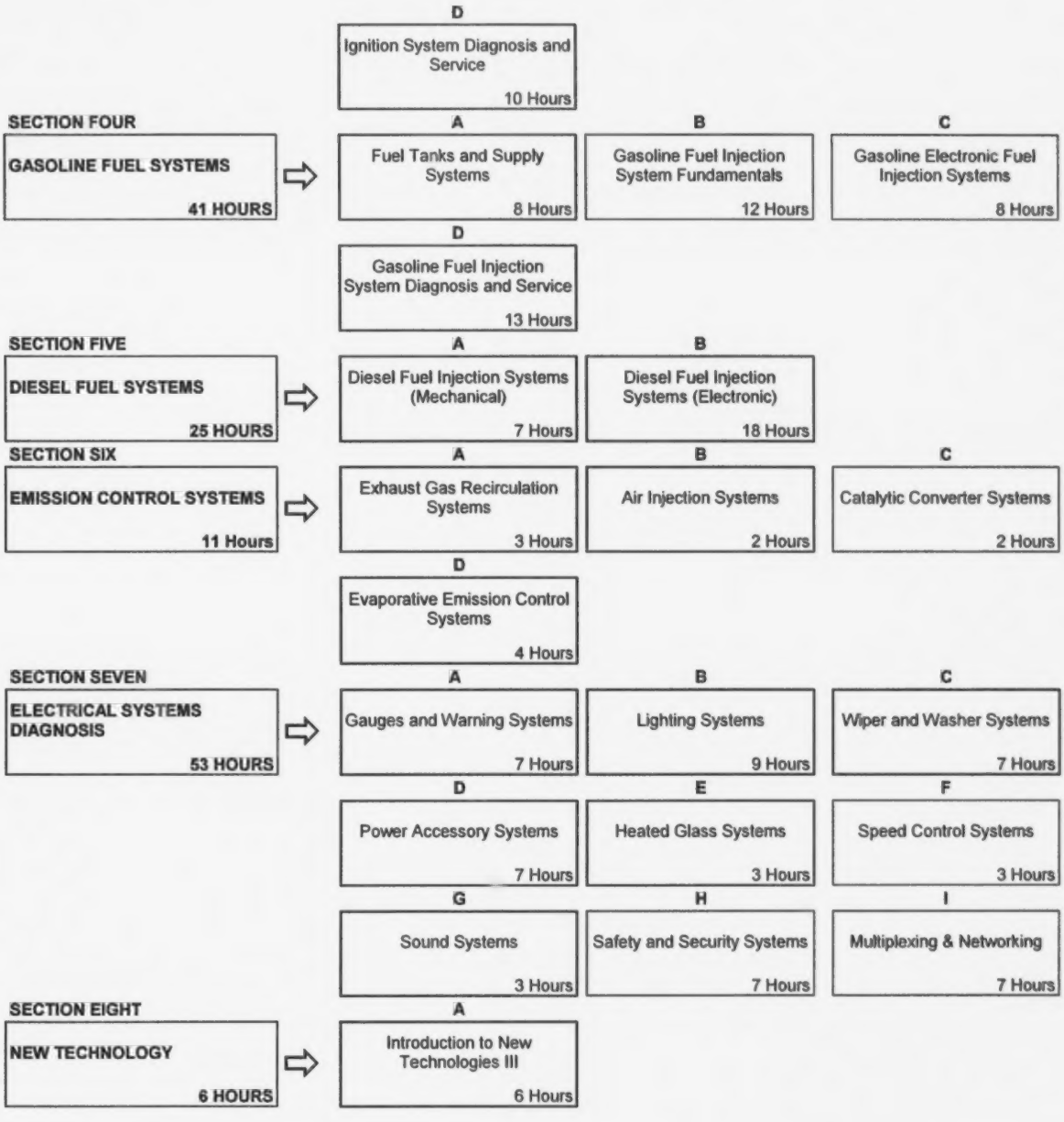
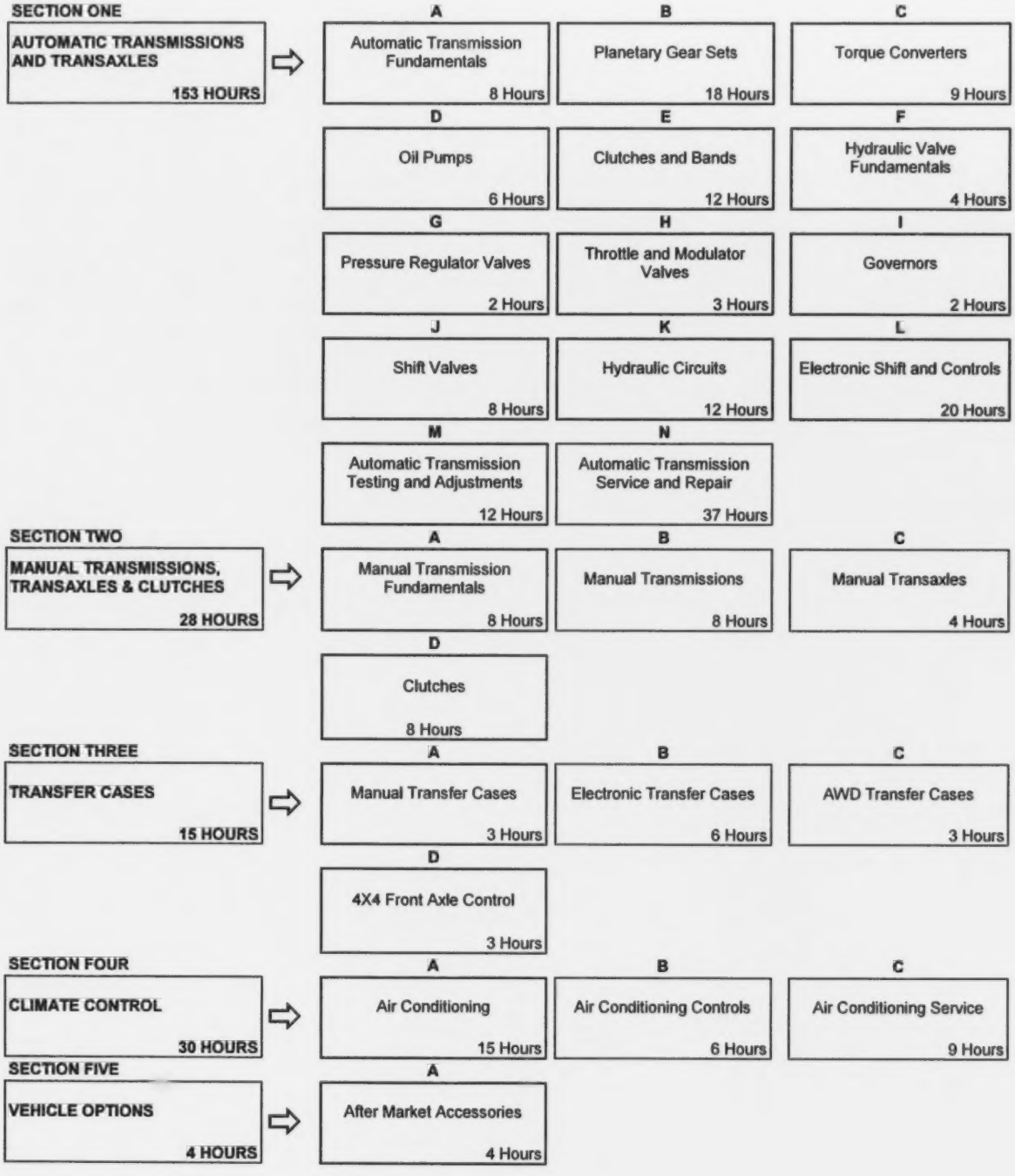
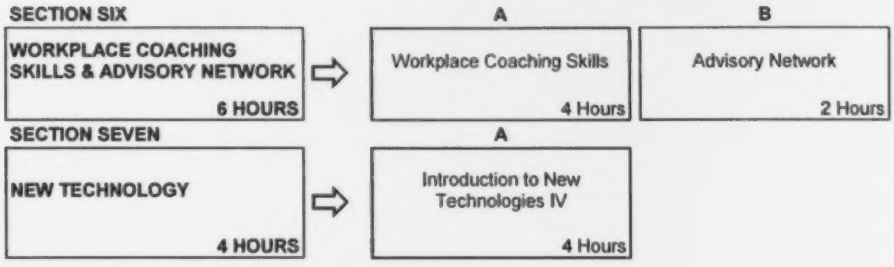
Third Period
(240 Hours)




D
Ignition System Diagnosis and Service
10 Hours
SECTION FOUR
GASOLINE FUEL SYSTEMS
41 HOURS
A
Fuel Tanks and Supply Systems
8 Hours
B
Gasoline Fuel Injection System Fundamentals
12 Hours
C
Gasoline Electronic Fuel Injection Systems
8 Hours
D
Gasoline Fuel Injection System Diagnosis and Service
13 Hours
SECTION FIVE
DIESEL FUEL SYSTEMS
25 HOURS
A
Diesel Fuel Injection Systems (Mechanical)
7 Hours
B
Diesel Fuel Injection Systems (Electronic)
18 Hours
SECTION SIX
EMISSION CONTROL SYSTEMS
11 Hours
A
Exhaust Gas Recirculation Systems
3 Hours
B
Air Injection Systems
2 Hours
C
Catalytic Converter Systems
2 Hours
D
Evaporative Emission Control Systems
4 Hours
SECTION SEVEN
ELECTRICAL SYSTEMS DIAGNOSIS
53 HOURS
A
Gauges and Warning Systems
7 Hours
B
Lighting Systems
9 Hours
C
Wiper and Washer Systems
7 Hours
D
Power Accessory Systems
7 Hours
E
Heated Glass Systems
3 Hours
F
Speed Control Systems
3 Hours
G
Sound Systems
3 Hours
H
Safety and Security Systems
7 Hours
I
Multiplexing & Networking
7 Hours
SECTION EIGHT
NEW TECHNOLOGY
6 HOURS
A
Introduction to New Technologies III
6 Hours

Automotive Service Technician Training Profile
Fourth Period
(240 Hours)





NOTE: The hours stated are for guidance and should be adhered to as closely as possible. However, adjustments must be made for rate of apprentice learning, statutory holidays, registration and examinations for the training establishment and Apprenticeship and Industry Training.

FIRST PERIOD TECHNICAL TRAINING
AUTOMOTIVE SERVICE TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE: ..... MATERIALS, TOOLS AND SAFETY ..... 27 HOURS

A. Communication ..... 2 Hours

Outcome: ***Communicate with customers and related trades people using industry standard terms and units for parts and operations.***

1. Name standard terms and units of measure for components and operations.
2. Effectively communicate trade related information with customers and other tradespeople.
3. Demonstrate understanding of various types of service literature (hard copy and electronic).

B. Measuring Tools ..... 12 Hours

Outcome: ***Measure components using measuring tools common to the trade.***

1. Convert numbers between decimals and fractions.
2. Perform linear measurements in imperial units.
3. Perform linear measurements in SI units.
4. Demonstrate correct care and use of measuring tools.
5. Perform torque measurements in imperial and SI units.

C. Specialty Hand Tools ..... 6 Hours

Outcome: ***Demonstrate the correct use of specialty hand tools common to the trade.***

1. Perform double lap and SI tube flaring.
2. Demonstrate knowledge of drills and reamers.
3. Demonstrate correct use of taps and dies.
4. Demonstrate thread repair and broken fastener removal.

D. Fastening Devices ..... 3 Hours

Outcome: ***Assemble components using a variety of fasteners, adhesives and sealers common to the trade.***

1. Demonstrate fastening and torquing procedures using threaded fasteners.
2. Demonstrate the use of other retaining devices (e.g. snap rings, set screws).
3. Demonstrate the use of sealers and adhesives common to the trade.
4. Demonstrate the use of tools and procedures for plastic trim fasteners.

E. Safety ..... 2 Hours

Outcome: ***Practice workshop safety at all times.***

1. Identify the key areas of employee responsibility concerning safety.
2. Demonstrate safe work habits.
3. Demonstrate correct procedures for working with exhaust gases.

F. Government Agencies ..... 2 Hours

Outcome: ***Describe the roles of various federal and provincial government agencies with regard to employment within the trade.***

1. Describe the function of Alberta Apprenticeship and Industry Training, Human Resources Development Canada, and Alberta Workplace Health and Safety.
2. Identify the rights and responsibilities of employees and employers concerning the above agencies.

SECTION TWO: ..... SAFE USE OF OXY-ACETYLENE AND GMAW (MIG) WELDING QUIPMENT ..... 12 HOURS

The intent of the following section is to train apprentices to a level where they may operate the required equipment in a safe manner, and perform such operations of metal cutting and tack welding as to make temporary attachment of component parts, prior to the finish welding required by a certified journeyperson Welder.

A. Oxy-Acetylene Heating and Cutting ..... 8 Hours

Outcome: ***Perform metal cutting and heating operations safely using oxy-acetylene equipment.***

1. Describe the characteristics of and handling procedures for oxygen and acetylene.
2. Demonstrate handling procedures for regulators and hoses.
3. Demonstrate the use, care and maintenance of torches and tips.
4. Perform basic cutting operations.
5. Demonstrate the use of personal protective equipment.

B. Gas Metal Arc Welding (GMAW) (MIG Welding) ..... 4 Hours

Outcome: ***Perform non-structural welding using GMAW (MIG) equipment.***

1. Demonstrate the safe set-up and operation of GMAW equipment.
2. Explain the purpose of shielding gases.
3. Describe the maintenance for gun assemblies and GMAW equipment.
4. Demonstrate the proper preparation of material for using MIG welding equipment including the types of welds and types of basic joints.

SECTION THREE: .....DRIVE LINES.....9 HOURS

A. Drive Lines.....9 Hours

Outcome: ***Diagnose, service and repair drive lines, universal joints and constant velocity joints.***

1. Explain the construction, design features, operation, and function of common drive line components.
2. Service and repair drive shaft assemblies.
3. Service and repair common types of universal and constant velocity joints.
4. Diagnose and repair driveline vibration problems.

SECTION FOUR: .....SUSPENSION AND STEERING.....89 HOURS

A. Frames .....3 Hours

Outcome: ***Identify automotive frame damage.***

1. Identify frame damage using knowledge of frame construction and design features.
2. Perform frame-checking procedures.

B. Suspension and Steering Linkage Systems .....13 Hours

Outcome: ***Service and repair suspensions systems and steering linkages.***

1. Describe the construction and design features of common suspension systems.
2. Explain the operating principles of suspension systems.
3. Diagnose and service suspension systems.
4. Identify steering linkage types and explain their operation.
5. Diagnose and service steering linkages.

C. Wheels, Hubs and Tires .....9 Hours

Outcome: ***Diagnose and service wheels, tires and wheel bearings.***

1. Explain the construction, sizing, rating and design features of tires and wheels.
2. Demonstrate the correct procedures for balancing and installing wheels and tires.
3. Perform correct inspection, cleaning and repacking of common wheel bearings.
4. Demonstrate the correct procedures for installing and adjusting wheel bearings.
5. Diagnose problems related to and service wheels, tires and wheel bearings.

D. Manual Steering .....4 Hours

Outcome: ***Diagnose, service and repair manual steering gear assemblies.***

1. Explain the construction and design features of common manual steering gears.
2. Adjust, repair and diagnose problems related to manual steering gears.

E. Power Steering ..... 14 Hours

Outcome: ***Diagnose, service and repair power steering systems.***

1. Explain the construction and design features of power steering gears.
2. Identify power steering pump types and explain their operation.
3. Explain the operating principles of power steering systems.
4. Diagnose, repair and adjust non rack and pinion power steering gears.
5. Diagnose, repair and adjust rack and pinion power steering gears.
6. Diagnose power steering problems.

F. Steering Angles ..... 14 Hours

Outcome: ***Describe the common steering angles and how each affects vehicle handling.***

1. Describe the function and effect of caster on vehicle operation.
2. Describe the function and effect of camber on vehicle operation.
3. Describe the function and effect of steering axis inclination on vehicle operation.
4. Describe the function and effect of toe on vehicle operation.
5. Describe the effect of thrust angle on vehicle operation.
6. Describe the measurement procedures for each wheel alignment angle.
7. Describe the adjustment procedures for each wheel alignment angle.

G. Alignment Procedures ..... 18 Hours

Outcome: ***Perform a wheel alignment.***

1. Perform a pre-alignment inspection to locate and identify faulty components.
2. Select the most appropriate alignment settings within specifications for a given vehicle type and load condition.
3. Perform a wheel alignment to adjust the alignment angles according to guidelines.
4. Adjust steering linkage to establish the correct toe setting and properly center the steering wheel.
5. Road test a vehicle to verify correct alignment or confirm alignment problems.

H. Steering Columns ..... 5 Hours

Outcome: ***Service and repair steering columns and their related safety devices.***

1. Explain the construction, design features and operation of steering column safety features.
2. Service and repair steering columns and related safety devices.
3. Safely disarm, remove, install and re-arm a steering column air bag.

I. Suspension and Steering Diagnosis .....9 Hours

Outcome: ***Diagnose and correct suspension and steering problems.***

1. Diagnose problems related to steering systems.
2. Diagnose problems related to suspension systems.
3. Choose the most appropriate repair methods to correct suspension and steering problems.

SECTION FIVE:..... BRAKE SYSTEMS .....49 HOURS

A. Brake System Fundamentals.....5 Hours

Outcome: ***Apply scientific principles to explain brake system operation.***

1. Explain the operating principles of brake systems with emphasis on hydraulic forces and friction.
2. Choose the correct brake fluid for a given application based on the purpose, function, and characteristics of brake fluids.
3. State Pascal's Law and its implications for brake systems.

B. Hydraulic System Components.....11 Hours

Outcome: ***Service and repair brake system hydraulic components.***

1. Explain the operating principles, construction and design features of common types of brake master cylinders.
2. Explain the operating principles, construction and design features of wheel cylinders and calipers used in brake systems.
3. Explain the construction and design features of brake hoses and lines.
4. Explain the purpose and operation of the metering, proportioning and pressure differential valves.
5. Describe the operation of the hydraulic components when used as a system.
6. Diagnose, service, adjust and repair brake system hydraulic components.

C. Drum Brake Systems.....8 Hours

Outcome: ***Service and repair drum brake systems.***

1. Explain the construction, design features and operation of drum brake system components.
2. Service, adjust and repair drum brake systems.
3. Explain the construction and design features of drum type parking brake systems.
4. Service, adjust and repair drum type park brake systems.

D. Disc Brake Systems ..... 8 Hours

Outcome: ***Service and repair disc brake systems.***

1. Explain the construction, operation and design features of disc brake system components.
2. Service and repair disc brake systems.
3. Explain the construction and operation of disc type parking brake systems.
4. Service, adjust and repair disc type park brake systems.

E. Power Brakes ..... 5 Hours

Outcome: ***Diagnose and service power brakes.***

1. Describe the operation of a vacuum operated power brake unit.
2. Describe the operation of hydraulically operated power brake units.
3. Demonstrate the procedures for testing a power brake unit.
4. Diagnose problems related to a power brake.

F. Brake System Diagnosis and Service ..... 4 Hours

Outcome: ***Service, repair and diagnose problems related to brake systems.***

1. Demonstrate brake flushing and bleeding procedures on brake systems.
2. Diagnose problems related to brake systems.

G. Antilock Brake Systems ..... 8 Hours

Outcome: ***Diagnose and service antilock brake systems.***

1. Identify basic ABS components.
2. Explain the operation of an ABS system.
3. Demonstrate the brake bleeding procedures for an ABS system.
4. Demonstrate the diagnostic procedure for an ABS system.

SECTION SIX: ..... ELECTRICAL I ..... 39 HOURS

A. Electrical Fundamentals ..... 4 Hours

Outcome: ***Apply scientific principles to explain basic electrical theory.***

1. Explain the physical qualities of insulators, conductors and semi-conductors.
2. Explain the physical qualities and units of measure used for electromotive force, current, resistance and power.

B. Electrical Circuits ..... 16 Hours

Outcome: ***Solve problems related to automotive electrical systems.***

1. Recognize common electrical symbols used in the trade.
2. Identify the three basic circuit types and their basic electrical properties.
3. Identify and explain an open, short or grounded circuit.
4. Using Ohm's Law, calculate for any of its variables when two are known.

5. Apply Ohm's Law to a circuit to calculate voltage, current and resistance, as well as determine the effects of circuit faults on a circuit.
6. Calculate power and explain the implications of power requirements in circuit design.
7. Perform voltage drop and circuit resistance measurements using a voltmeter.
8. Perform parasitic drain and current draw tests using an ammeter.
9. Measure electrical resistance using an ohmmeter.

C. Fundamentals of Magnetism .....4 Hours

Outcome: ***Apply scientific principles to explain the fundamentals of magnetism.***

1. Explain magnetism and electromagnetism, and their properties.
2. Explain the construction and operation of electromagnetic coils.
3. Explain how magnetism or electromagnetism can be used to.
4. Change electrical energy into mechanical energy.
5. Change mechanical energy into electrical energy.
6. Explain how to change electrical energy into another form of energy.

D. Batteries.....6 Hours

Outcome: ***Service, test and diagnose problems related to batteries.***

1. Explain the purpose, construction, operation and ratings of batteries.
2. Test and service batteries.
3. Diagnose problems attributed to batteries.
4. Perform battery charging and boosting operations.

E. Electrical System Diagnosis I .....9 Hours

Outcome: ***Test and repair simple electrical circuits.***

1. Use appropriate test equipment to test simple circuits and interrupt results.
2. Perform simple wire and connector repairs.
3. Demonstrate an ability to master the hazards associated with electrostatic discharge (ESD) and vehicle electronic systems.

SECTION SEVEN: ..... SCAN TOOLS ..... 3 HOURS

A. Introduction to Scan Tools .....3 Hours

Outcome: ***Demonstrate a basic understanding and use of scan tools.***

1. Perform the basic functions of scan tools.
2. Perform diagnostic and function tests on ABS and restraint systems.

SECTION EIGHT:.....PASSENGER RESTRAINT SYSTEMS.....9 HOURS

A. Active Restraint Systems.....1 Hour

Outcome: ***Describe the purpose, function and operation of active passenger restraint systems.***

1. Explain the purpose of active restraint systems.
2. Identify the components of an active restraint system.

B. Passive Restraint Systems.....8 Hours

Outcome: ***Diagnose and service passive restraint systems.***

1. Explain the purpose of passive restraint systems.
2. Identify components of a passive restraint system.
3. Diagnose and service inflatable restraint systems.

SECTION NINE:.....NEW TECHNOLOGY.....3 HOURS

A. Introduction to New Technologies I.....3 Hours

Outcome: ***Demonstrate an awareness of new and emerging technologies related to first year material.***

1. Explain the basic operating principles of new technologies applied to automobiles.

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UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE:..... ENGINES ..... 133 HOURS

A. Engine Fundamentals .....9 Hours

Outcome: ***Describe the operation of internal combustion engines that use a variety of common fuel types.***

1. Explain the stages of development of the internal combustion engine.
2. Identify and explain common engine classifications, terms and definitions.
3. Explain the principles of engine operation for both two and four stroke cycle engines.
4. Compare and contrast the physical and operational differences between engines that use different types of fuel.

B. Blocks and Related Components (Theory).....4 Hours

Outcome: ***Describe how the engine block forms the foundation to support all other engine components.***

1. Explain the purpose, construction and design features of the block and its related components.
2. Identify and state the purpose of various types of cylinder sleeves and liners.

C. Blocks and Related Components (Service) .....4 Hours

Outcome: ***Disassemble, inspect, measure, and reassemble the engine block and its related components.***

1. Inspect and measure engine blocks.
2. Describe the procedures for servicing worn engines.

D. Crankshafts, Friction Bearings and Related Components (Theory) .....8 Hours

Outcome: ***Describe crankshaft and friction bearing function, design and construction.***

1. Explain the function, design features and operating principles of crankshafts.
2. Describe the function, characteristics and design features of friction bearings and explain how bearings are constructed.
3. Explain the function, design features and operating principles of balance shafts, auxiliary shafts, flywheels and harmonic balancers.
4. Explain how the crankshaft and related components are balanced with respect to each other.

E. Crankshafts, Friction Bearings and Related Components (Service) ..... 4 Hours

Outcome: ***Inspect and measure a crankshaft, friction bearings and/or related components.***

1. Inspect and measure crankshafts to determine service worthiness.
2. Identify service procedures for crankshafts, balance shafts, flywheels, and harmonic balancers.
3. Explain the correct installation techniques for crankshafts and harmonic balancers.

F. Pistons, Piston Rings and Connecting Rods (Theory) ..... 8 Hours

Outcome: ***Describe the function and design features of pistons, piston rings, piston pins, and connecting rods.***

1. Explain the function, construction and design features of pistons and piston pins.
2. Explain the function, construction and design features of piston rings.
3. Explain the function, construction and design features of connecting rods.
4. State how the pistons, piston rings and piston pins are lubricated by engine oil.
5. Explain how piston mass and connecting rod balance are critical to total engine balance.

G. Pistons, Piston Rings and Connecting Rods (Service) ..... 4 Hours

Outcome: ***Measure and inspect pistons, piston pins, piston rings, and connecting rods.***

1. Measure and inspect pistons, piston pins and rings to ensure correct fit to each other and the cylinders.
2. Outline the procedures to service connecting rods.
3. Demonstrate the procedures to install piston and rod assemblies into cylinders.

H. Camshafts and Valve Trains (Theory) ..... 6 Hours

Outcome: ***Describe how the camshaft and valve train components interact to operate the engine valves.***

1. Explain the construction, design features and functions of the various valve train components.
2. Identify different methods for metering lubricating oil in the valve train.
3. Describe the operation of various types of drive mechanisms for timing camshafts.
4. Interpret valve-timing diagrams.

I. Camshafts and Valve Trains (Service) ..... 4 Hours

Outcome: ***Diagnose camshafts and valve train components.***

1. Measure, test and inspect camshafts and lifters.
2. Measure, test and inspect valve train drive mechanisms.
3. Measure, test and inspect rocker arms, push rods and other valve train components.

J. Cylinder Head Assemblies (Theory) ..... 8 Hours

Outcome: ***Describe the operation and function of the various components that make up a cylinder head.***

1. State the purpose of and identify common combustion chamber designs used in gasoline and/or diesel engines.
2. Explain the purpose, construction and design features of cylinder heads.

3. State the purpose, function and design features of valves, valve springs and associated hardware.
4. State the purpose, function and design features of valve guides and valve seats.

K. Cylinder Head Assemblies (Service) ..... 8 Hours

Outcome: ***Inspect and measure cylinder heads and related components.***

1. Demonstrate correct cylinder head removal and installation procedures.
2. Inspect and measure cylinder heads.
3. Inspect and measure valves.
4. Inspect and measure valve guides.
5. Inspect and measure valve seats.
6. Inspect and measure valve springs.
7. Describe the procedures required to obtain correct valve face to seat contact.
8. Assemble a cylinder head.

L. Engine Disassembly Procedures ..... 4 Hours

Outcome: ***Use service literature to safely disassemble engines and their attached components.***

1. Disassemble an engine following written instructions.

M. Engine Assembly Procedures ..... 5 Hours

Outcome: ***Use service literature to safely assemble engines and their attached components.***

1. Assemble an engine following written instructions.

N. Air Induction Systems ..... 5 Hours

Outcome: ***Service air induction systems and related components.***

1. Identify the type of induction system used on an engine.
2. Describe the purpose and design features of intake manifolds.
3. Correctly remove and install an intake manifold.
4. Describe the parts, construction and operating principles of a turbo charger and supercharger.
5. Identify the maintenance requirements and service precautions for turbo chargers and superchargers.
6. Explain the function of and perform service procedures for common types of air cleaners.

O. Exhaust Systems ..... 3 Hours

Outcome: ***Understand exhaust systems and the dangers of exhaust fumes.***

1. Explain the function and design features of exhaust system components.
2. Identify exhaust system components; understand removal and replacement procedures.
3. Demonstrate safe venting procedures for engine exhaust fumes.

P. Emission Control Systems ..... 12 Hours

Outcome: ***Describe the scope and depth of vehicle emission problems; explain the various emission control systems used to keep emissions under control and service positive crankcase ventilation systems.***

1. Explain the scientific principles involving the combustion process, vehicle emissions and their interrelationships.
2. Explain the purpose and types of catalytic converter systems.
3. Explain the purpose and types of exhaust gas recirculation systems.
4. Explain the purpose and types of air injection systems.
5. Explain the purpose and operation of positive crankcase ventilation systems.
6. Explain the purpose and operation of heated air intake systems.
7. Diagnose problems related to and service positive crankcase ventilation systems.

Q. Lubrication Systems ..... 11 Hours

Outcome: ***Diagnose, service and repair problems related to lubricating systems and their associated components.***

1. Identify and describe the common functions and characteristics of lubricating oils.
2. Explain the operating principles of common types of lubrication systems and their related components.
3. Diagnose, service and repair problems related to full flow lubrication systems.
4. Demonstrate correct procedures to follow when disposing of lubricants and filters.
5. Describe the use of oil analysis as a diagnostic tool.

R. Cooling Systems..... 11 Hours

Outcome: ***Safely diagnose, service and repair problems related to cooling systems and their related components.***

1. Describe the physical principles involved in heat transfer.
2. Describe the purpose, construction and operation of liquid cooling systems and their related components.
3. Explain the operating sequence of a cooling system equipped with a thermatic fan and thermostat.
4. Diagnose, service and repair problems related to liquid cooling systems and their related components.
5. Explain the operation and test procedures for temperature indicators.
6. Describe correct procedures to follow when disposing of coolants.

S. Engine Diagnosis..... 15 Hours

Outcome: ***Diagnose common engine problems using engine test equipment and general engine knowledge.***

1. Perform engine diagnostic procedures using common engine test equipment.
2. Diagnose various common engine problems.
3. Explain the importance of using the physical senses when diagnosing engine problems.

SECOND PERIOD

SECTION TWO: ..... DRIVE AXLE ASSEMBLIES ..... 52 HOURS

A. Axles and Bearings ..... 6 Hours

Outcome: ***Identify types of axle shafts and explain how different types of bearings are used to support the axles and wheels of a drive axle assembly.***

1. Identify the common types of axle shafts by the types and locations of the bearings used to support the axles or wheels on drive axle assemblies.
2. Explain the function of major components of a drive axle assembly.
3. Explain how axle and wheel bearings are retained, adjusted and lubricated.

B. Differentials ..... 12 Hours

Outcome: ***Describe the design characteristics and operation of common differential types.***

1. Explain the purpose, construction and operation of standard differentials.
2. Explain the purpose, construction and operation of traction enhancing differentials.
3. Perform a variety of calculations to determine the influence of a differential on output torque and speeds.
4. State the lubricating requirements for the common types of differentials.

C. Final Drive Gear Sets ..... 16 Hours

Outcome: ***Describe the design characteristics and operation of common types of final drive gear sets and perform the steps necessary to assemble a gear set and obtain an industry acceptable contact pattern.***

1. Explain the purpose, design features and operation of final drive gear sets.
2. Classify final drive gear sets by ratio, tooth design, number of drive pinion gear bearings and carrier types.
3. Calculate final drive gear ratios.
4. Trace the path of power from the drive pinion gear to the axle.
5. Explain how the final drive gear set support bearings are lubricated.
6. Identify an industry acceptable contact pattern for a hypoid type crown and drive pinion gear set.
7. Demonstrate the effect that moving the drive pinion or crown gears into or out of mesh has on the contact pattern.
8. Demonstrate the use of depth gauges and explain the concept of 'nominal depth'.
9. Perform calculations for correct shim selection when installing different types of drive pinion gears.

D. Drive Axle Assembly Diagnosis and Service ..... 18 Hours

Outcome: ***Diagnose problems related to and service all the components of the common types of drive axles.***

1. Diagnose problems related to drive axles.
2. Measure gear backlash, bearing preload and gear runout.
3. Interpret a hypoid type crown and pinion gear set contact pattern for diagnostic purposes.
4. Demonstrate procedure to test a traction-enhancing differential.

5. Diagnose problems related to and service all drive axle, differential case and drive pinion gear bearings and seals.

SECTION THREE: ..... ELECTRICAL II ..... 28 HOURS

A. Electrical Fundamentals II ..... 5 Hours

Outcome: ***Review first period technical training to re-familiarize themselves with electrical terms, formulas and meters.***

1. Review electron theory and basic properties of electricity and magnetism.
2. Apply Ohm's law to electrical circuits to calculate any of its three variables.
3. Demonstrate the use of the three basic electrical meters to identify opens, shorts or grounds in an automobile electrical circuit.

B. Electrical Circuits ..... 8 Hours

Outcome: ***Predict current and voltage values in any automotive circuit and service electrical circuit protection devices.***

1. Interpret electrical circuit diagrams.
2. Calculate current, voltage and resistance in any part of a series or parallel circuit.
3. Explain the operation and service procedures for common circuit protection devices.

C. Electrical System Diagnosis II ..... 15 Hours

Outcome: ***Perform electrical tests on specific electrical systems or components to verify proper operation or diagnose problems.***

1. Connect scan tools to vehicles and interpret scan data on applicable second period AST systems.
2. Connect charging system test equipment and interpret the equipment readings.
3. Use an appropriate electrical test meter to test a/an:
   a) oxygen sensor
   b) knock sensor
   c) throttle position sensor
   d) speed sensor

SECTION FOUR: ..... CHARGING SYSTEMS ..... 12 HOURS

A. Charging Systems and Control Circuits ..... 6 Hours

Outcome: ***Describe the operation of a charging system, its control circuits and related components.***

1. Explain the operating principles of an alternator.
2. Explain the purpose, construction and operation of a vehicle charging system and its related components.
3. Explain the purpose, operation and construction of voltage regulators.
4. Explain the purpose, construction and operation of instrument panel charge indicator/warning devices.

B. Charging System Testing and Diagnosis ..... 6 Hours

Outcome: ***Perform tests and diagnose faults on charging systems and their related components.***

1. Perform common charging system diagnostic routines.
2. Interpret results and diagnose problems from the data obtained while performing charging system diagnostic tests.
3. Demonstrate procedures for testing of charging system components and associated wiring.

SECTION FIVE: ..... STARTING SYSTEMS ..... 12 HOURS

A. DC Motor Fundamentals ..... 2 Hours

Outcome: ***Describe the operation and applications of various types of DC motors.***

1. Explain the operating principles of DC motors.

B. Starter Motors and Control Circuits ..... 4 Hours

Outcome: ***Describe the operation of a starter motor and each component within a starter system.***

1. Explain the purpose, construction and operation of starter motors and their related components.
2. Using wiring diagrams, explain the operation of starter motor electrical circuits.

C. Starting System Testing and Diagnosis ..... 6 Hours

Outcome: ***Perform tests and diagnose problems related to starting systems.***

1. Perform starter system and component diagnostic routines, interpret results and diagnose problems from the data obtained.
2. Use sounds heard during performance of the starter motor load test to aid in starter motor diagnosis.
3. Demonstrate procedures for testing of starting system components and associated wiring.

SECTION SIX: ..... NEW TECHNOLOGY ..... 3 HOURS

A. Introduction to New Technologies II ..... 3 Hours

Outcome: ***Demonstrate an awareness of new and emerging technologies related to second period material.***

1. Explain the basic operating principles of new technologies applied to automobiles.

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SECTION ONE:..... ELECTRICAL III ..... 66 HOURS

A. Electrical Fundamentals III ..... 6 Hours

Outcome: ***Re-familiarize themselves with electrical terms and test procedures presented in the first and second periods of technical training.***

1. Interpret electrical circuit diagrams.
2. Explain the purpose and operation of common circuit protection devices.
3. Connect scan tools to vehicles and interpret scan data.
4. Locate opens, shorts or grounds in an automobile electrical circuit using the three basic electrical meters.
5. Connect charging system test equipment and interpret the equipment readings.

B. Electronic Devices ..... 6 Hours

Outcome: ***Test discrete electronic components used in automotive electrical systems.***

1. Explain the properties and operating principles of common semiconductor materials.
2. Explain the construction, operation, applications and test procedures for diodes, Zener diodes, transistors, capacitors and inductors.

C. Computer Inputs, Switches and Sensors ..... 9 Hours

Outcome: ***Describe and test common computer inputs used in a wide variety of electronically controlled systems.***

1. Explain the operation and construction of the following types of sensors:
   a) potentiometers
   b) resistor/thermistor
   c) inductive
   d) oxygen
   e) frequency generator
   f) hall effect
2. Explain how and where discrete switches are used as computer inputs.
3. State applications for each of the listed sensor types.
4. Explain the term ~~-~~feedback loop" and how various sensors are used in a feedback system.
5. Test each of the listed sensor types.

D. On-Board Computers ..... 9 Hours

Outcome: ***Describe the operation of microprocessor based automotive modules and computers.***

1. Explain the functions of a microprocessor, an electronic module and a computer.
2. Explain how computers interact with inputs, outputs and other computers to control a circuit or system.

E. Computer Outputs and Output Devices ..... 9 Hours

Outcome: ***Describe how output devices are used to control a variety of vehicle systems through interaction with microprocessors.***

1. Explain common methods used by a computer to control output devices.
2. Explain the operation and construction of the following types of output devices:
   a) solenoids
   b) relays
   c) lamps
   d) motors
3. Explain how output devices interacting with microprocessors can be used to control a variety of vehicle systems.
4. Explain the purpose and operation of the data stream output.

F. Electronic Testing Equipment ..... 21 Hours

Outcome: ***Diagnose and solve vehicle systems problems using commonly available diagnostic test equipment.***

1. Demonstrate how to connect, use and interpret information from a variety of common automotive electronic test equipment.
2. Use service literature and vehicle diagnostic trouble codes to solve system failure problems.
3. Diagnose engine operation problems using an automotive oscilloscope.
4. Connect a scan tool to a vehicle to:
   a) retrieve and interpret scan data and diagnostic trouble codes
   b) operate various system outputs
   c) erase diagnostic trouble codes
   d) perform diagnostic tests on vehicle systems as are available through the scan tool
5. Demonstrate proficient use of scan tools in diagnosis of drivability problems on OBDI and OBDII systems.

G. Advanced Electrical Schematics ..... 6 Hours

Outcome: ***Demonstrate the ability to follow and understand wiring schematics.***

1. Understand and interpret automotive electrical wiring schematics.

SECTION TWO: ..... FUEL AND COMBUSTION FUNDAMENTALS ..... 12 HOURS

A. Fuel Properties ..... 4 Hours

Outcome: ***Demonstrate safe handling practices for fuels and explain the chemical properties of gasoline and diesel fuels.***

1. Describe the chemical properties of gasoline and diesel fuels.
2. Compare and contrast gasoline and diesel fuel properties.
3. Demonstrate safe and environmentally sensitive handling and storage practices for gasoline and diesel fuels.

B. Combustion and Exhaust Emissions ..... 4 Hours

Outcome: ***Describe the combustion process, the resulting emissions, and how air fuel ratio, ignition timing and engine modifications affect emissions.***

1. Describe the combustion process.
2. Identify the regulated and non-regulated emissions resulting from combustion.
3. Explain the effect on exhaust emissions caused by altering air fuel ratio, ignition timing or engine design.

C. Exhaust Gas Analysis ..... 4 Hours

Outcome: ***Diagnose engine operation problems using exhaust gas analyzers.***

1. Calibrate an exhaust gas analyzer.
2. Demonstrate the procedures required to obtain an accurate exhaust gas analysis.
3. Use exhaust gas analysis to diagnose a variety of engine operation problems.

SECTION THREE: ..... IGNITION SYSTEMS ..... 26 HOURS

A. Ignition System Fundamentals ..... 6 Hours

Outcome: ***Describe the operating principles and explain the operation of an ignition system and its related components.***

1. Explain the purpose, construction and operation of an ignition system and its related components.
2. State how ionization and induction apply to ignition systems.

B. Distributor Ignition Systems ..... 7 Hours

Outcome: ***Describe the operation of distributor ignition systems.***

1. Explain the operation of a basic ignition system.
2. Explain the function of an ignition module and its related components.
3. State the essential wiring connections to an ignition module.
4. Explain how a computer interacts with sensors and outputs to control an ignition system.
5. Identify the sensor inputs and output devices essential to operation of a computer controlled distributor ignition system.

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C. Electronic Ignition Systems ..... 3 Hours

Outcome: ***Describe the operation of electronic ignition systems.***

1. Explain the operation of distributorless ignition systems.

D. Ignition System Diagnosis and Service ..... 10 Hours

Outcome: ***Test and diagnose problems related to and make adjustments to ignition systems and their components.***

1. Test and diagnose problems related to ignition systems and their associated components using common electrical and electronic test equipment.
2. Diagnose ignition system problems from an oscilloscope analysis of primary or secondary patterns.
3. Remove, repair and reinstall distributors.

SECTION FOUR: .....GASOLINE FUEL SYSTEMS..... 41 HOURS

A. Fuel Tanks and Supply Systems..... 8 Hours

Outcome: ***Diagnose problems related to fuel tanks and supply systems, and service all associated components.***

1. Explain the purpose, construction and operation of fuel tanks, lines, filters and pumps.
2. Explain the safety devices employed in fuel supply systems.
3. Using wiring diagrams, explain the operation of electric fuel pump systems.
4. Explain the purpose and operation of fuel pressure regulators and accumulators.
5. Test and diagnose problems related to fuel tanks and supply systems and their associated components.
6. Service fuel supply system components.

B. Gasoline Fuel Injection System Fundamentals..... 12 Hours

Outcome: ***Identify the components and explain the operation of electronically controlled gasoline fuel injection systems.***

1. Explain the speed density and the mass air flow methods of air measurement, and identify the fuel injection systems where each is used.
2. Explain the purpose and operation of fuel injectors.
3. Explain the purpose, construction and operation of various common air mass measuring devices.
4. Explain the purpose and operation of common methods for controlling idle speed.
5. Explain why and how throttle position is measured.
6. Explain how and why air fuel mixtures are altered for various engine-operating conditions.
7. Identify the components necessary to operate a simple computer controlled fuel injection system.

C. Gasoline Electronic Fuel Injection Systems ..... 8 Hours

Outcome: ***Describe the operation of gasoline throttle body and multiport fuel injection systems.***

1. Explain the function, operation, advantages and disadvantages of a throttle body fuel injection system.
2. Explain the function, operation, advantages and disadvantages of a multiport fuel injection system.

D. Gasoline Fuel Injection System Diagnosis and Service ..... 13 Hours

Outcome: ***Test and diagnose problems related to fuel injection systems and associated components.***

1. Diagnose and repair problems related to gasoline fuel injection systems.
2. Test, diagnose and service fuel injectors.
3. Identify symptoms related to vacuum leaks in fuel-injected systems.
4. Demonstrate safe practices for working with fuel injectors.

SECTION FIVE: ..... DIESEL FUEL SYSTEMS ..... 25 HOURS

A. Diesel Fuel Injection Systems (Mechanical) ..... 7 Hours

Outcome: ***Understand the fundamental operation of mechanical diesel fuel injection systems and service injectors and glow plugs.***

1. Explain the fundamental operation and design features of currently used diesel fuel injection systems and their related components.
2. Test a diesel fuel injector.
3. Test a glow plug.
4. Describe on-vehicle maintenance, testing and adjustment procedures.

B. Diesel Fuel Injection Systems (Electronic) ..... 18 Hours

Outcome: ***Describe the fundamental operation of electronically controlled diesel fuel injection systems and service injectors and glow plugs.***

1. Explain the fundamental operation and design features of common electronically controlled diesel fuel injection systems and their related components.
2. Test an electronically controlled diesel fuel injector.
3. Test an electronically controlled glow plug.
4. Explain on-vehicle maintenance approved testing and adjustment procedures for electronically controlled diesel fuel injection systems.
5. Describe trouble shooting and repair procedures.

SECTION SIX: EMISSION CONTROL SYSTEMS ..... 11 HOURS

A. Exhaust Gas Recirculation Systems ..... 3 Hours

Outcome: Diagnose and repair exhaust gas recirculation systems.

1. Explain the purpose, construction and operation of exhaust gas recirculation systems.
2. Diagnose and repair exhaust gas recirculation systems.

B. Air Injection Systems ..... 2 Hours

Outcome: Diagnose and repair air injection systems.

1. Explain the purpose, construction and operation of air injection systems.
2. Diagnose and repair air injection systems.

C. Catalytic Converter Systems 2 Hours4

Outcome: Diagnose and repair catalytic converter systems.

1. Explain the purpose, construction and operation of catalytic converter systems.
2. Diagnose and repair catalytic converter systems.

D. Evaporative Emission Control Systems ..... 4 Hours

Outcome: Diagnose and repair evaporative emission control systems.

1. Identify the sources of evaporative emissions.
2. Explain the purpose, construction and operation of evaporative emission control systems.
3. Diagnose and repair evaporative emission control systems.

SECTION SEVEN: ELECTRICAL SYSTEMS DIAGNOSIS ..... 53 HOURS

A. Gauges and Warning Systems ..... 7 Hours

Outcome: Diagnose and repair various instrument panel gauge circuits and warning systems.

1. Explain the operation of common instrument panel gauges.
2. Explain the operation of common visual and audible warning devices.
3. Diagnose and repair problems related to warning devices.

B. Lighting Systems ..... 9 Hours

Outcome: Diagnose and repair faults related to vehicle lighting systems.

1. Explain the purpose and operation of various vehicle lighting systems and their related components.
2. Diagnose and repair faults related to vehicle lighting systems, including daytime running light systems.
3. Properly align headlamps.

C. Wiper and Washer Systems ..... 7 Hours

Outcome: ***Diagnose and repair problems related to various wiper and washer systems.***

1. Explain the purpose and operation of various wiper and washer systems.
2. Diagnose and repair faults related to wiper and washer systems.

D. Power Accessory Systems ..... 7 Hours

Outcome: ***Diagnose and repair problems related to power accessories.***

1. Explain the operation of power seat adjusters, power door locks and power windows.
2. Diagnose and repair problems associated with power accessories.

E. Heated Glass Systems ..... 3 Hours

Outcome: ***Diagnose and repair faults related to heated glass systems.***

1. Explain the operation and service procedures of rear window defrosters.
2. Diagnose and repair faults with heated window systems.

F. Speed Control Systems ..... 3 Hours

Outcome: ***Diagnose problems related to vehicle speed control systems.***

1. Explain the operation of vehicle speed control systems.
2. Diagnose problems related to vehicle speed control systems.

G. Sound Systems ..... 3 Hours

Outcome: ***Diagnose problems related to sound systems and associated components.***

1. Diagnose problems related to sound systems and associated components.

H. Safety and Security Systems ..... 7 Hours

Outcome: ***Diagnose and repair faults related to various factory installed vehicle safety and security systems.***

1. Diagnose and repair problems related to factory installed vehicle entry and anti-theft systems.

I. Multiplexing and Networking ..... 7 Hours

Outcome: ***Perform troubleshooting procedures on multiplex systems.***

1. Explain the principle, functions and types of multiplexing.
2. Understand and perform the test procedures for multiplex systems.

SECTION EIGHT: ..... NEW TECHNOLOGY ..... 6 HOURS

A. Introduction to New Technologies III ..... 6 Hours

Outcome: ***Demonstrate an awareness of new and emerging technologies related to third year material.***

1. Explain the basic operating principles of new technology.

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SECTION ONE:.....AUTOMATIC TRANSMISSIONS AND TRANSAXLES..... 153 HOURS

A. Automatic Transmission Fundamentals ..... 8 Hours

Outcome: ***Describe the purpose and operating principles of an automatic transmission.***

1. Explain the operating principles of an automatic transmission.
2. Explain the purpose, types and characteristics of transmission fluids.

B. Planetary Gear Sets..... 18 Hours

Outcome: ***Diagnose problems related to and repair planetary gear sets.***

1. State the purpose and function of a planetary gear set.
2. Explain the construction, parts and operating principles of a simple planetary gear set.
3. Identify the drive, driven and held members of a planetary gear set in all forward and reverse ranges. Check the gear ratios of a simple planetary gear set.
4. Explain the construction, parts and operating principles of a compound planetary gear set.
5. Diagnose simple and compound planetary gear set failures.

C. Torque Converters ..... 9 Hours

Outcome: ***Diagnose problems related to the operation of torque converters and their related control circuits.***

1. Explain the purpose, parts and operation of a lock up torque converter.
2. Explain the operation of various torque converter control circuits and valves.
3. Diagnose problems related to faulty torque converters, control circuits, valves and, their effects on transmission operation.

D. Oil Pumps ..... 6 Hours

Outcome: ***Diagnose problems related to and repair automatic transmission oil pumps.***

1. Describe the function, parts and operation of a fixed displacement automatic transmission oil pump.
2. Describe the function, parts and operation of a variable displacement automatic transmission oil pump.
3. Diagnose problems related to faulty automatic transmission oil pumps.
4. Disassemble, repair and reassemble automatic transmission oil pump.

E. Clutches and Bands ..... 12 Hours

Outcome: ***Diagnose, adjust and repair automatic transmission clutches, bands and servos.***

1. Explain the purpose, parts and operation of clutch assemblies, pistons and seals.
2. Explain the purpose, parts and operation of transmission bands and servo assemblies.
3. Service and adjust automatic transmission bands and clutches.
4. State the effects on automatic transmission operation caused by faulty clutches, bands or servos.
5. Diagnose problems related to faulty clutches, bands and servos.

F. Hydraulic Valve Fundamentals ..... 4 Hours

Outcome: ***Describe the construction and operation of simple hydraulic valves used in automatic transmissions.***

1. Explain the operation of simple types of hydraulic valves used in automatic transmissions.
2. Explain the purpose and operation of a manual valve in all speed ranges.
3. Diagnose manual valve problems.

G. Pressure Regulator Valves ..... 2 Hours

Outcome: ***Describe the operation of automatic transmission pressure regulating valves.***

1. Describe the purpose and operation of pressure regulating valves used in automatic transmissions.
2. Explain how throttle opening and gear selection are used to affect automatic transmission main line pressure.

H. Throttle and Modulator Valves ..... 3 Hours

Outcome: ***Diagnose and repair throttle and modulator valves.***

1. Describe the purpose, construction and operation of common types of throttle and modulator valves.
2. Explain how throttle valves are operated and how their operation affects automatic transmission operation.
3. Explain how modulator valves operate and their affects on automatic transmission operation.
4. Diagnose faults associated with defective throttle valves and modulators and describe their effects on transmission operation.

I. Governors ..... 2 Hours

Outcome: ***Diagnose problems associated with governors.***

1. Describe the function, operation and construction of governors.
2. Diagnose problems related to governors.

J. Shift Valves ..... 8 Hours

Outcome: ***Diagnose and repair shift valves.***

1. Explain the purpose, construction and operation of a shift valve.
2. State how various driving conditions affect the operation of a shift valve.
3. Diagnose problems associated with shift valves and explain how they will affect automatic transmission operation.

K. Hydraulic Circuits ..... 12 Hours

Outcome: ***Diagnose automatic transmission problems using hydraulic circuit diagrams.***

1. Identify basic oil circuits and use a hydraulic circuit diagram to trace the flow of oil in an automatic transmission and explain how one circuit influences other circuits.
2. Diagnose automatic transmission problems related to hydraulic circuits.

L. Electronic Shift and Controls ..... 20 Hours

Outcome: ***Diagnose problems related to electronically controlled automatic transmissions.***

1. Compare the operation of an electronically controlled automatic transmission to that of a hydraulically controlled transmission.
2. Explain how electronics are used to control an automatic transmission.
3. Explain how electronic controls are used to control a lock up torque converter.
4. Diagnose problems related to the electronic controls of an electronically controlled automatic transmission.

M. Automatic Transmission Testing and Adjustments ..... 12 Hours

Outcome: ***Test an automatic transmission to assess operation and adjust to optimize performance.***

1. Test and verify proper transmission operation.
2. Perform hydraulic pressure tests on an automatic transmission to diagnose failures.
3. Adjust throttle linkages on an automatic transmission.
4. Road test a vehicle equipped with an automatic transmission to verify proper transmission operation.
5. Perform scan tool diagnostics on a running unit.

N. Automatic Transmission Service and Repair ..... 37 Hours

Outcome: ***Service and repair automatic transmissions.***

1. Disassemble an automatic transmission and its sub-assemblies and inspect all components for serviceability using approved service manual procedures.
2. Service, reassemble and adjust an automatic transmission using approved service manual procedures.

SECTION TWO: .....MANUAL TRANSMISSIONS, TRANSAXLES AND CLUTCHES ..... 28 HOURS

A. Manual Transmission Fundamentals ..... 8 Hours

Outcome: ***Describe the purpose and operating principles of a manual transmission.***

1. Explain the operating principles of a manual transmission.
2. Trace the path of power through a manual transmission or transaxle in all gear ranges.
3. Identify gear designs and calculate gear ratios and torque multiplication.
4. Choose the correct type of lubricant for use in a manual transmission or transaxle and explain how their internal components are lubricated.
5. Describe the operation of synchromesh units.
6. Explain the purpose and operation of shift mechanisms.
7. Identify types of bearings and seals used in manual transmissions and transaxles.

B. Manual Transmissions ..... 8 Hours

Outcome: ***Diagnose problems related to a manual transmission or any of its related components.***

1. Describe the purpose, construction and operation of a manual transmission and its components.
2. Disassemble and reassemble a manual transmission using a shop manual.
3. Adjust manual transmission linkages.
4. Diagnose problems related to manual transmissions.

C. Manual Transaxles ..... 4 Hours

Outcome: ***Diagnose problems related to a manual transaxle or any of its related components.***

1. Describe the purpose, construction and operation of a manual transaxle and its components.
2. Explain the disassembly and reassembly of a manual transaxle.
3. Explain the adjustment of manual transaxle linkages.
4. Diagnose problems related to manual transaxles.

D. Clutches ..... 8 Hours

Outcome: ***Diagnose and service automotive clutches and their related components.***

1. Explain the operating principles of a clutch.
2. Explain the construction, design features, and function of a clutch.
3. Explain the service and adjustment of a clutch assembly.
4. Diagnose problems related to a clutch assembly.

SECTION THREE: .....TRANSFER CASES ..... 15 HOURS

A. Manual Transfer Cases ..... 3 Hours

Outcome: ***Describe the operation of common types of manual transfer cases.***

1. Explain the purpose and operation of a manual transfer case.
2. Demonstrate the ability to diagnosis a problem in a manual transfer case.

B. Electronic Transfer Cases ..... 6 Hours

Outcome: ***Describe the operation and diagnosis of electronic transfer cases.***

1. Describe the operations of electronic transfer cases.
2. Diagnose problems related to electronic shift controls.

C. AWD Transfer Cases ..... 3 Hours

Outcome: ***Describe the operation of AWD transfer cases.***

1. Describe operations of AWD transfer cases and their components.
2. Explain the procedure for diagnosing a problem in an AWD transfer case.

D. 4X4 Front Axle Control ..... 3 Hours

Outcome: ***Describe the operation of locking hubs/axles.***

1. Describe the purpose and operation of locking hubs/axles on a 4X4 front axle.
2. Diagnose problems related to locking hubs/axles.

SECTION FOUR: ..... CLIMATE CONTROL ..... 30 HOURS

A. Air Conditioning ..... 15 Hours

Outcome: ***Diagnose problems related to air conditioning systems or any of their related components.***

1. Identify the environmental concerns with air conditioning systems.
2. Explain the principles and properties of heat.
3. Explain the properties of refrigerants and refrigerant oils.
4. Demonstrate the safety precautions to be followed when handling refrigerants and refrigerant oils.
5. Explain the function of compressors, condensers, evaporators and accumulator/dryers in air conditioning systems.
6. Explain the function of refrigerant metering devices used in air conditioning systems.
7. Diagnose problems and outline repair procedures related to air conditioning systems using common leak, pressure and temperature testing equipment.

B. Air Conditioning Controls ..... 6 Hours

Outcome: ***Describe the operation and diagnostic capabilities of air conditioning controls.***

1. Identify and explain the operation of components used for temperature control and air distribution.
2. Explain how air conditioning controls may be integrated with other vehicle electronic systems.
3. Diagnose electronic air conditioning controls by accessing their on-board diagnostic capabilities.

C. Air Conditioning Service ..... 9 Hours

Outcome: ***Service and repair air conditioning systems and components.***

1. Identify the type of refrigerant used in an air conditioning system.
2. Recover, recycle and recharge air conditioning systems according to legislated guidelines.
3. Repair or replace defective air conditioning components.

SECTION FIVE: ..... VEHICLE OPTIONS ..... 4 HOURS

A. After Market Accessories ..... 4 Hours

Outcome: ***Demonstrate an awareness of a variety of common after market devices.***

1. Understand the implications of installing a variety of after market devices into an automobile.

SECTION SIX: ..... WORKPLACE COACHING SKILLS & ADVISORY NETWORK ..... 6 HOURS

A. Workplace Coaching Skills ..... 4 Hours

1. Describe and demonstrate the coaching skills used for training apprentices.

B. Advisory Network ..... 2 Hours

1. Explain the role and purpose of the advisory network system in the Automotive Service Technician trade.

SECTION SEVEN: ..... NEW TECHNOLOGY ..... 4 HOURS

A. Introduction to New Technologies IV ..... 4 Hours

Outcome: ***Demonstrate an awareness of new and emerging technologies related to the trade.***

1. Explain the basic operating principles of new technologies applied to automobiles.

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